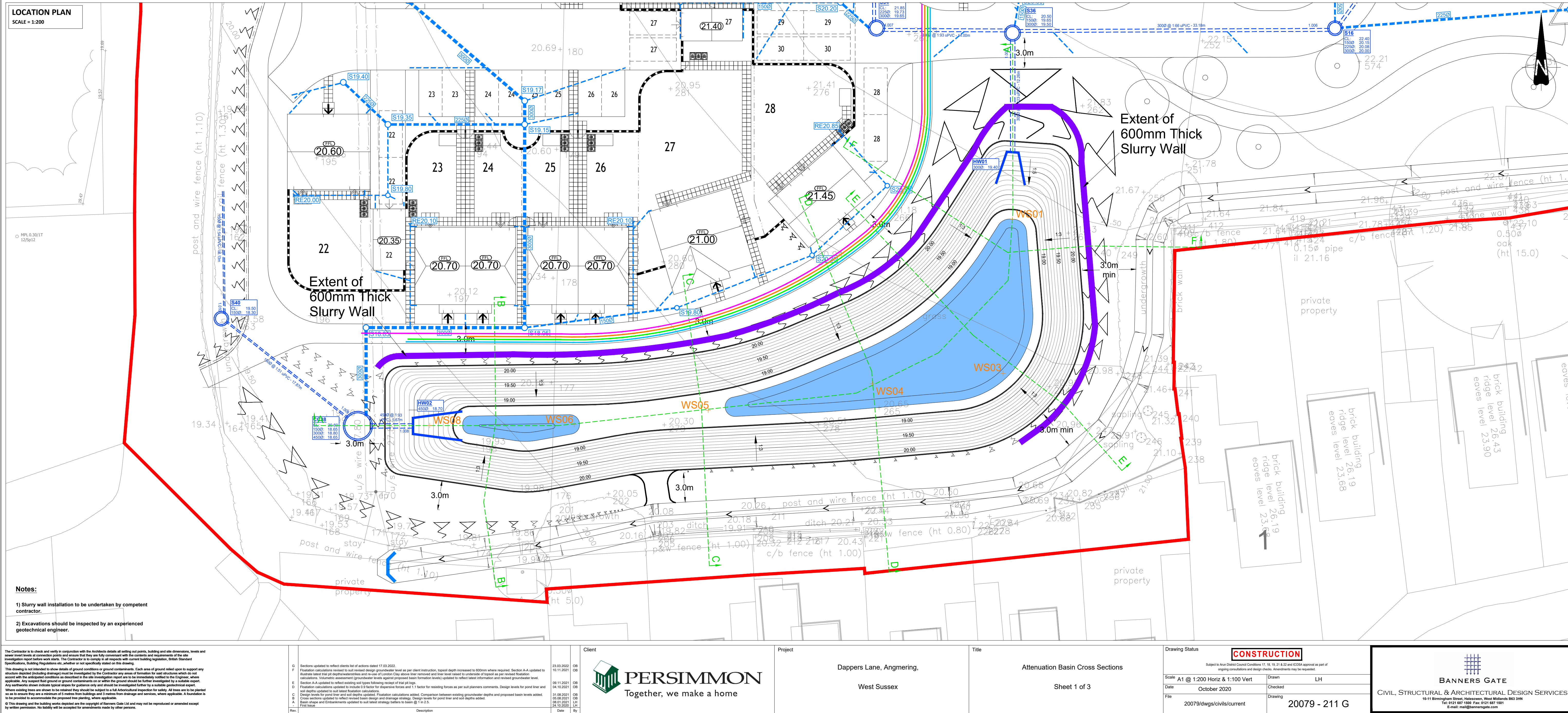


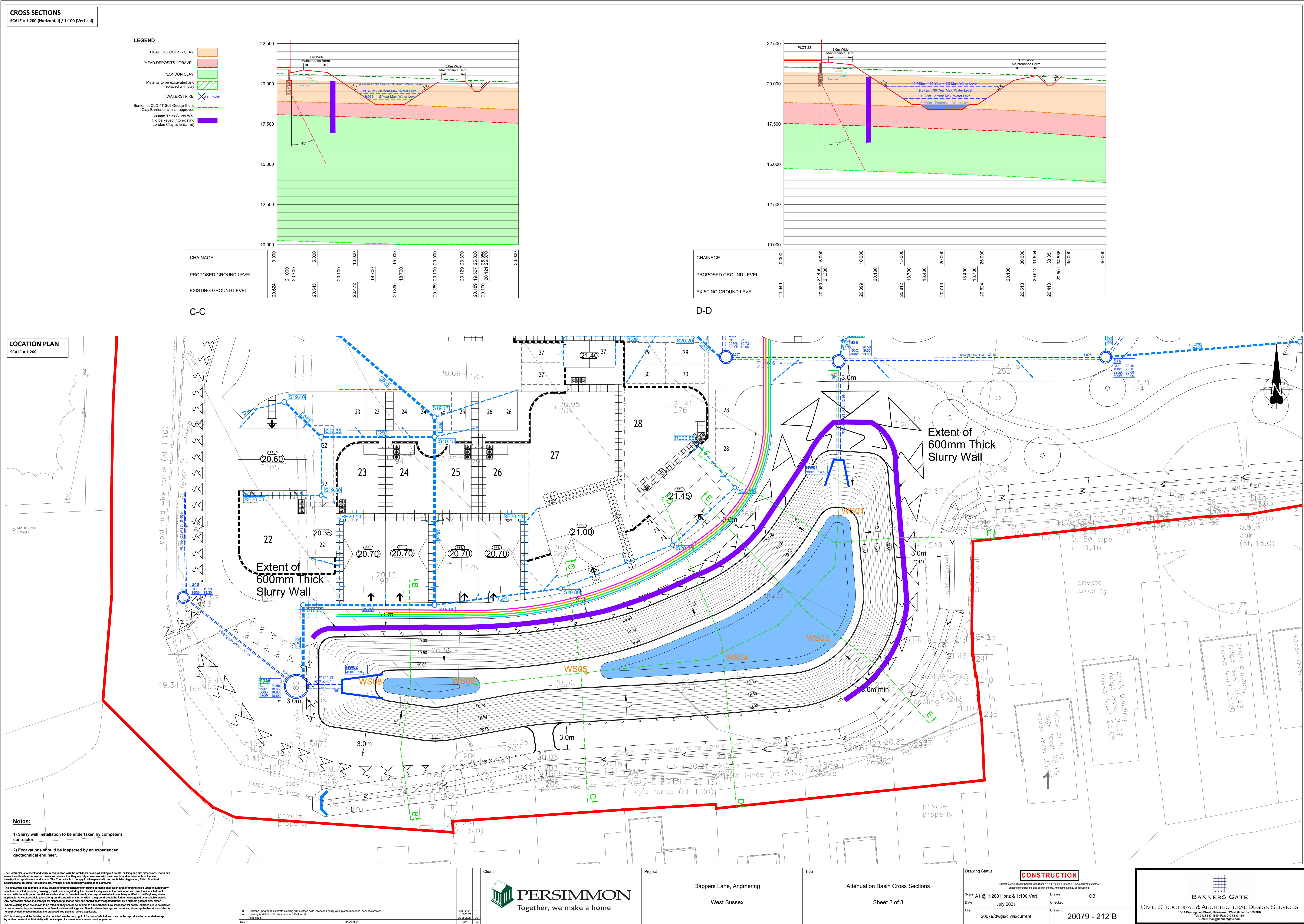
Project Title	Dapper's Lane, Angmering	Project No	20079
Client	Persimmon Homes Thames Valley		
Prepared By	S Marshall/C O'Brien	Date	23 rd March 2022
Subject	Civil Engineer Design Development Note (Rev A)		

Item	Subject
1.	<u>Introduction</u> This Technical Note has been produced to detail the Civil Engineering design development following receipt and review of the RPS Letter Report dated 07th March 2022 and titled 'Geotechnical and Hydrogeological Review'. This can be used by Arun District Council to understand how the recommendations have informed the revised design and how the recommendations have been suitably achieved, which should close out all design matters and enable a discharge of condition number 18 and 19 in relation to planning ref: A/76/20/PL. The following key should be used for the below stated report recommendations and the respective actions / design decisions / responses: <i>RPS statement from Section 6.2 of their Letter Report: (italics)</i> Response (bold bullet points)
2.	<i>Since the monitoring installations have been constructed across geological strata, the current historical boreholes do not allow for an assessment of groundwater conditions that may specifically exist within the Valley Gravel deposits separately from the mudstone / claystone within the London Clay Formation. As such at this stage the design should consider the worse-case groundwater levels as obtained by LEAP in WS3 and WS102 as being the minimum design levels for further consideration of the effects of groundwater on the Attenuation Pond, on the assumption that they are derived from the Valley Gravel deposits.</i> Based on the above recommendations, the design considers the worst case groundwater levels as obtained by LEAP in WS3 and WS102 (LEAP January 2020 report) as being the minimum design levels. However, it is noted that the groundwater is assumed to be derived from the Valley Gravel deposits and not the low permeability Clays as originally understood.
3.	<i>In the absence of confirmation data specifically on the effects of any hydraulic uplift from the London Clay, sufficient partial factors of safety should be applied to make allowance in the design of the potential variability. We would therefore recommend that loads should be factored in the Ultimate Limit State (ULS) design conditions using a partial factor of 1.1 for destabilising actions (e.g. porewater pressure), and 0.9 for stabilising permanent actions (e.g. water and soil weight), in accordance with an EC7 design approach.</i> The design solution elements discussed in the following sections mean that groundwater pressures under the intended location will be mitigated by a cut off wall and therefore no buoyancy design will be required as there will be no groundwater beneath the pond. Refer to Sections 4-7 of this Technical Note.

4.	<i>To mitigate the groundwater pressures at site, consideration could be given to the following, critically subject to detailed design and further hydrogeological assessment and modelling of the base flow groundwater. The following elements are critically not presented as a final design solution, rather as being an option to consider further. Each competent needs to be reviewed as part of the final design solution:</i> • All components have been reviewed and, where appropriate, incorporated into the revised final design as detailed in Sections 5-7 within this Technical Note.
5.	<i>Installation of a cut off wall / drain to the northern and eastern perimeter of pond extending into the top of the London Clay to allow control of groundwater pressures on the side slopes and allow transfer of groundwater to the attenuation pond outfall pipe network and hence prevent groundwater mounding up slope of the pond. The cut off wall/ drain could be used to assist in control of groundwater during construction to facilitate subsequent excavation and placement of clay and geomembrane liners in dry conditions.</i> • A bentonite slurry cut off wall is proposed to the northern and eastern perimeter of the pond to allow control of groundwater pressures on the side slopes. • The cut off wall is proposed to extend 1m into the top of the London Clay to cut off groundwater within the Gravel layer. • The overall depth of the cut off wall is approximately 5m below ground level in order to be keyed into the London Clay. Trenches can be excavated to about 12-15m deep using long reach hydraulic back-actors (backhoes). There are no buildability concerns in relation to this element of the proposed design. • It is unlikely that groundwater will mound and collect on the northern side of the slurry wall due to the granular layer abutting it. This will naturally enable the ground water derived within this gravel layer (as noted in Section 2 of this Technical Note) to flow freely within this layer and around the pond / cut off wall extents via the topography of the site sloping south-west.
6.	<i>Over excavation of the granular layer, from beneath the Attenuation Pond to the top of the London Clay Formation to remove the principal water bearing strata from within the footprint of the pond. The resultant excavation could then be backfilled to pond invert level with a suitable engineered low permeability clay overlain by a geomembrane. The clay liner and geomembrane should extend up the slopes to the proposed crest level.</i> • The granular layer is to be removed from beneath the pond and replaced with low permeability clay overlain by a geosynthetic clay barrier. The geosynthetic clay barrier will follow the geometry of the pond up the banks where it will be tied into the Clay strata no deeper than 600mm bgl. There are no concerns relating to buildability or future maintenance of this method of construction.
7.	<i>Reassessment of the surface water drainage strategy and calculations to confirm that the current pond has sufficient storage to account not only for attenuation of flows above the site surface water control discharge rate limits, but also to allow a contribution of calculated groundwater baseflow if the final solution needs to accommodate further contributions of inflow made from collection of groundwater from any associated control measures outside of the pond.</i>

	Groundwater flows will not be introduced into the proposed surface water drainage system. Any groundwater flows will flow around the slurry wall and continue within the valley gravels.
8.	<i>Alternative solutions to an open pond, could also be considered to provide attenuation of surface water flow such as a reinforced or precast concrete storage system that could be designed to accommodate uplift pressures. Consideration may need to be required to allow for anchor piles, to resist residual uplift pressures should the weight of the structure not be sufficient to resist the uplift forces from groundwater.</i> - Due to the proposed cut off wall, removal of gravel layer and replacement with low permeability clay, as well as the Geosynthetic clay barrier pond liner, groundwater will be mitigated from the area of the pond and therefore uplift pressures are taken as negligible with certainty. - Based on the above described design elements being associated with the pond design, an alternative solution is not required to be investigated further.
9.	<i>In addition, the volume of attenuation flow storage could be reduced by installation of on line storage within oversized pipes within the development network (with associated control devices as required), such that storage is provided within the entire network and not solely within the final pond/structure. A reduction in volume may reduce the depth of excavation and hence resultant uplift pressures for the storage structure.</i> Based on the above described design solution elements being associated with the pond design, an alternative solution is not required to be investigated further. This also mitigates any further design work in relation to the wider surface water drainage network and enables a prompt review by the Local Planning Authority.
10.	Conclusion This Technical Note has provided a detailed commentary on the Civil Engineering design development following receipt and review of the RPS Letter Report dated 07th March 2022 and titled 'Geotechnical and Hydrogeological Review'. The commentary details are clearly demonstrated on the following drawings: 20079-211 G – Attenuation Basin Cross Sections (Sheet 1 of 3) 20079-212 B – Attenuation Basin Cross Sections (Sheet 2 of 3) 20079-213 – Attenuation Basin Cross Sections (Sheet 3 of 3) 20079-330 C – Pond Inlet and Outlet Headwall Details (HW01 & HW02) It is our view that this revised design is in full accordance with the recommendations of the RPS report and as such should now be sufficient for the Local Planning Authority to discharge the associated planning conditions in confidence.

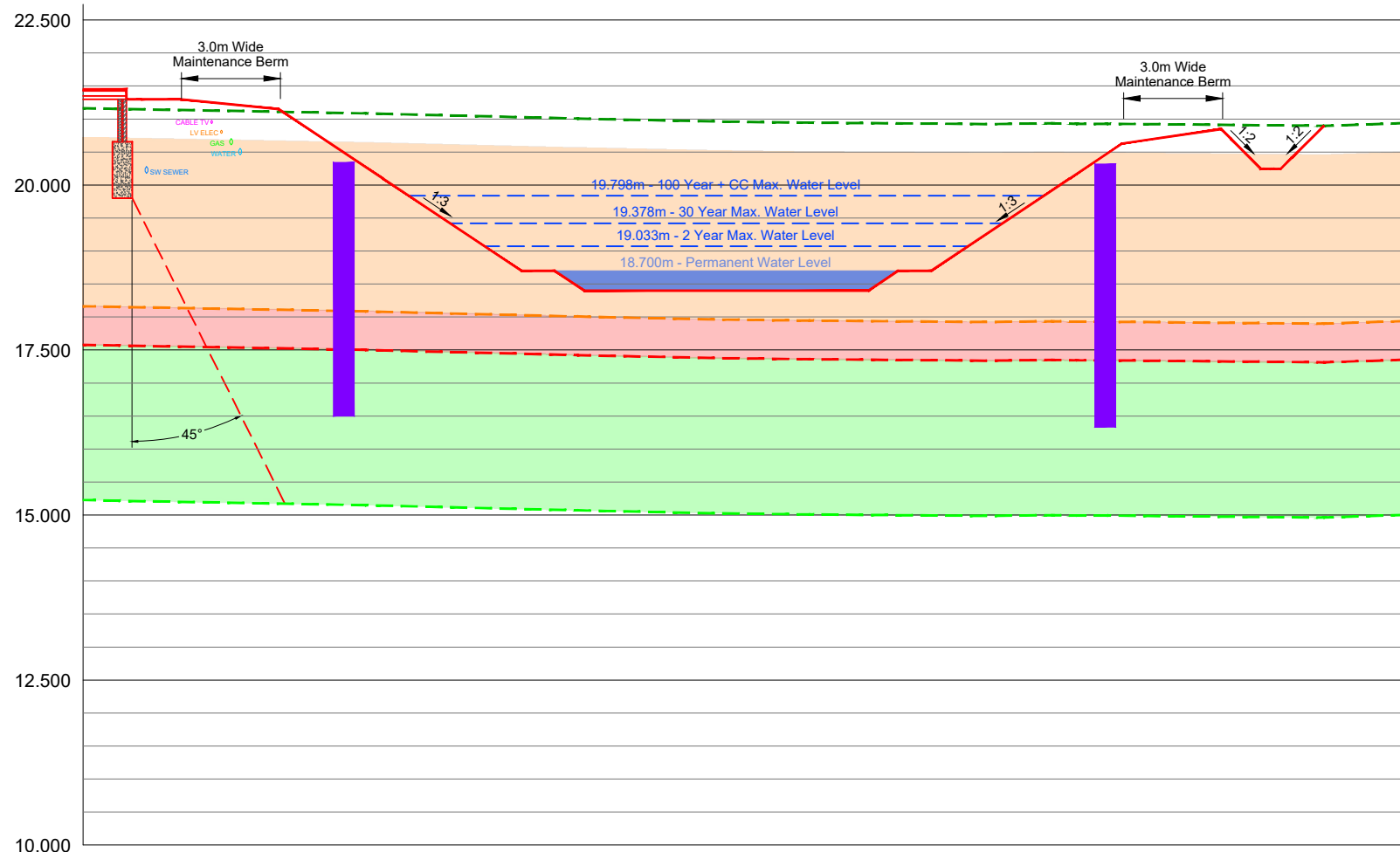




CROSS SECTIONS
SCALE = 1:200 (Horizontal) / 1:100 (Vertical)

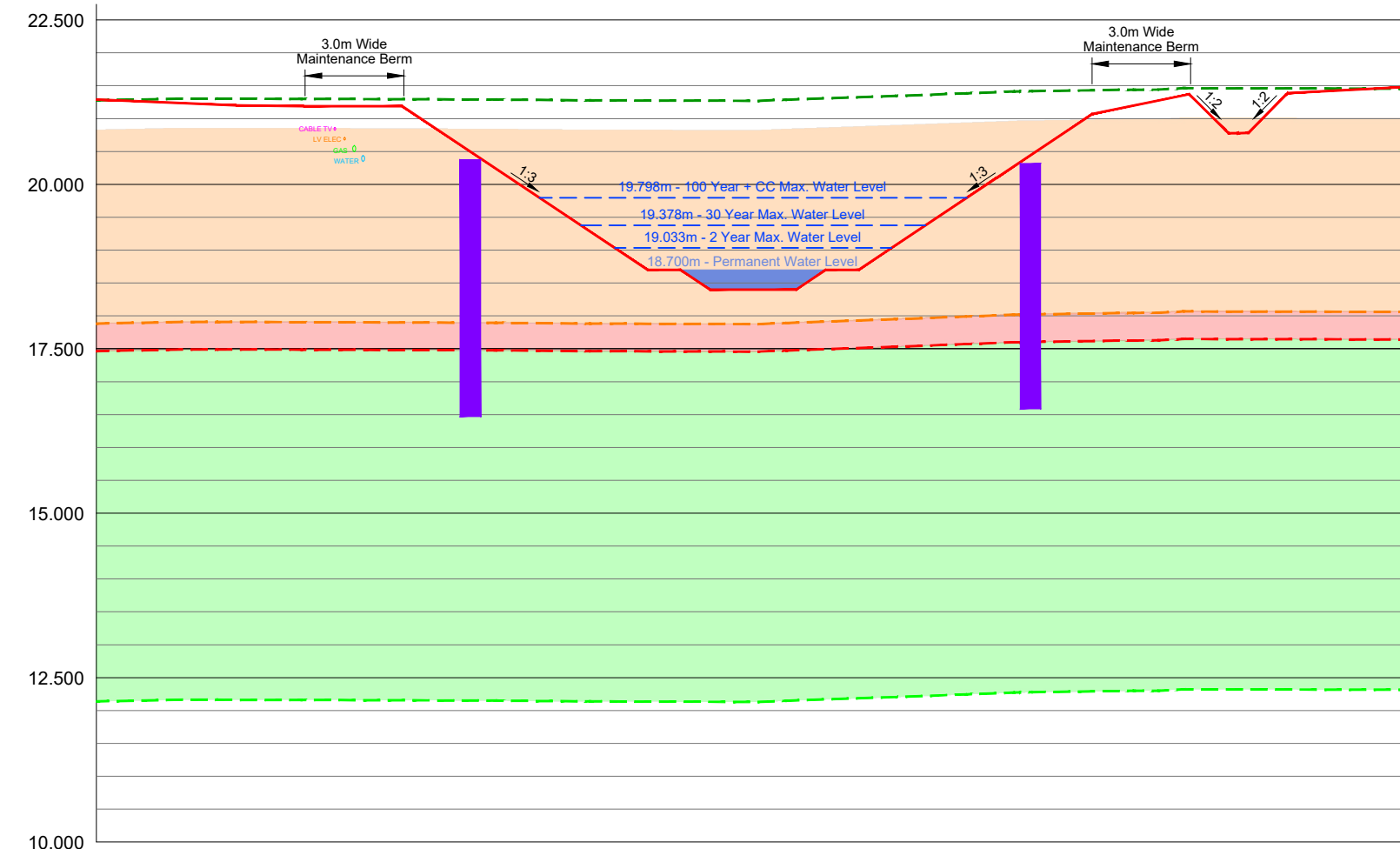
LEGEND

- 'HEAD DEPOSITS - CLAY'
- 'HEAD DEPOSITS - GRAVEL'
- 'LONDON CLAY'
- Material to be excavated and replaced with clay
- 'WATERSTRIKE' X/S - 17.00m
- Bentomat CLO.5T Self Geosynthetic Clay Barrier or similar approved
- 600mm Thick Slurry Wall (To be keyed into existing London Clay at least 1m)



CHAINAGE	0.000	5.000	10.000	15.000	20.000	25.000	30.000	34.471	40.000
PROPOSED GROUND LEVEL	21.450	21.300	20.100	18.700	20.848	18.400	20.929	20.840	20.837
EXISTING GROUND LEVEL	21.164	21.118	21.087	21.007	20.957	20.933	20.929	20.910	20.837

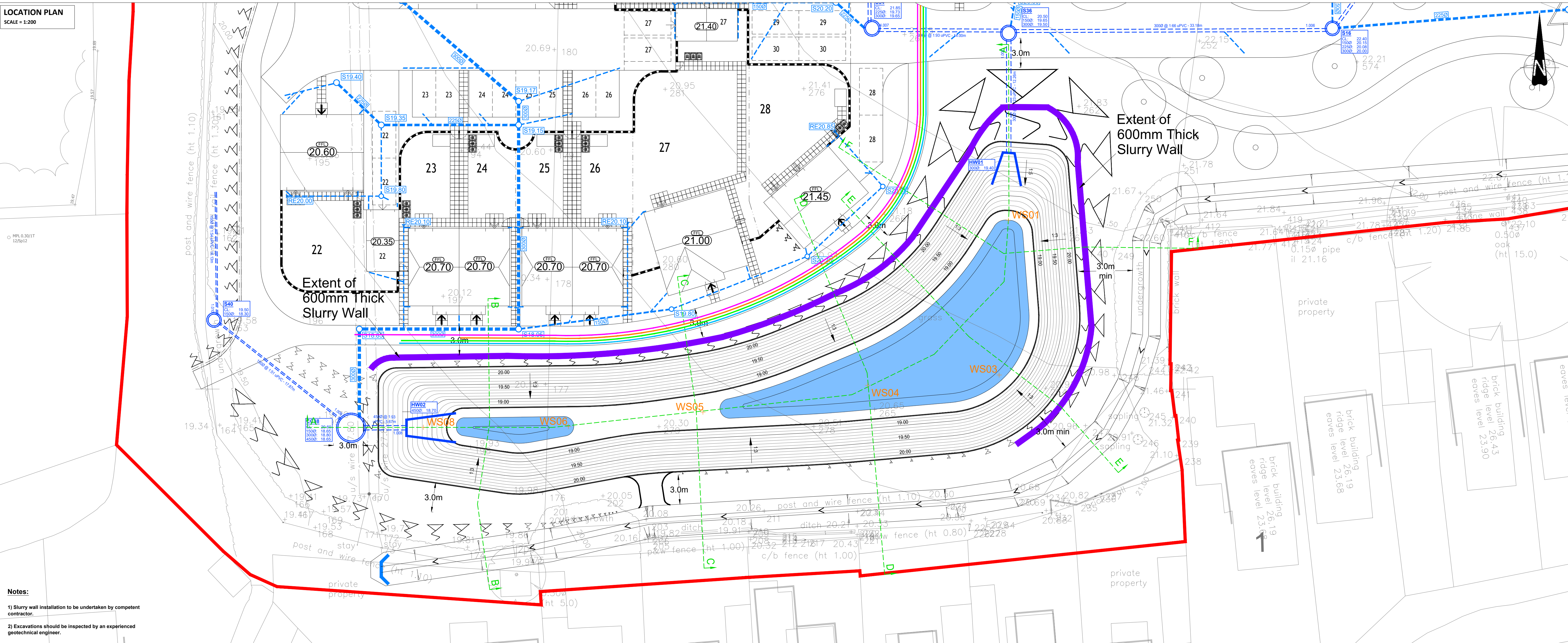
E-E



CHAINAGE	0.000	5.000	10.000	15.000	20.000	25.000	30.000	34.471	40.000
PROPOSED GROUND LEVEL	21.450	21.300	20.100	18.700	20.848	18.400	20.929	20.840	20.837
EXISTING GROUND LEVEL	21.164	21.118	21.087	21.007	20.957	20.933	20.929	20.910	20.837

F-F

LOCATION PLAN
SCALE = 1:200



Notes:

- Slurry wall installation to be undertaken by competent contractor.
- Excavations should be inspected by an experienced geotechnical engineer.

The Contractor is to check and verify in conjunction with the Architects details all setting out points, building and site dimensions, levels and sewer invert levels at connection points and ensure that they are fully consistent with the contents and requirements of the site investigation report before work starts. The Contractor is to comply with all aspects with current building regulations, British Standard specifications, Building Regulations etc. and/or as may be specifically stated on the drawing.

This drawing is not intended to show details of ground conditions or ground contaminants. Each area of ground relied upon to support any structure depicted (including drainage) must be investigated by the Contractor any areas of formation for said structures which do not accord with the stipulated conditions as described in the site investigation report are to be remediated notified to the Engineer, where appropriate. Any report that ground or ground contaminants or within the ground should be further investigated by a suitable report.

Any earthworks shown indicate typical slopes for guidance only and should be investigated further by a suitable geotechnical report.

Where existing lines are shown to be retained they should be subject to a full geotechnical inspection for safety. All trees are to be planted so as to ensure they are a minimum of 5 metres from buildings and 3 metres from drainage and services, where applicable. A foundation is to be provided to accommodate the proposed line parking, where applicable.

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First Issue	Date	By
20.03.2022	OB	

Client

PERSIMMON
Together, we make a home

Project

Dappers Lane, Angmering
West Sussex

Title

Attenuation Basin Cross Sections

Sheet 3 of 3

Drawing Status	CONSTRUCTION
Scale	A1 @ 1:200 Horiz & 1:100 Vert
Date	March 2022
File	20079/dwgs/civils/current
Drawn	OB
Checked	
Drawing	
20079 - 213	

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Pipe diameter (mm)	Effective length (m)
150-600	0.60m
601-750	1.00m
750 and over	1.25m



1. All dimensions in millimeters.
2. Generally the angle between the direction of flow of the receiving wastewater and the outfall pipe shall be 45 degrees.
3. All reinforcement concrete edges to be finished with a 25 x 25 fillet.
4. Minimum cover to reinforcement in the top face of the base slab to be 40mm.
5. The bed and opposite bank of the wastewater may in certain circumstances need to be protected by 225 to 300 thick un-coursed rubble pitching laid on a 100 thick concrete bed (refer to note B) and painted class M1-matched. The stone for pitching shall consist of large smooth faces stones roughly dressed square and shall be laid in a half brick bond with mortar. Bunter sandstone, Keuper waterstones and Carboniferous shales and mudstones are not to be used.
6. An Outlet Gully (as specified on the below table must be provided on all outfalls where pipe diameters are 375mm and above.
7. Secure handling shall be supplied where a maximum of 2 metres or more where a distance of less than 2 metres carries an increased risk of injury due to the landing surface.
8. FND2 to be used for soil conditions Sulphate class only. Designated risk references FND3, FND4A & FND4B. FND4B soil conditions with sulphates class 3, 4 and 5. FND4B reference.

[illegible]

Project

Dappers Lane, Angmering
West Sussex

Pond Inlet and Outlet Headwall Details

Drawing Status		PRELIMINARY	
Subject to Icosas approval as part of ongoing consultations and design check, amendments may therefore be requested			
Scale	1:20 @ A1	Drawn	WJI
Date	Oct 2020	Checked	LH
File	dwg/civils/current	Drawing	20079 / 330 C


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